

2018-05-19

An Exploratory Study on the Northern Sea Route as an Alternative Shipping Passage

Solvang, HB

<http://hdl.handle.net/10026.1/11151>

10.1080/03088839.2018.1446104

Maritime Policy and Management

Taylor & Francis (Routledge)

All content in PEARL is protected by copyright law. Author manuscripts are made available in accordance with publisher policies. Please cite only the published version using the details provided on the item record or document. In the absence of an open licence (e.g. Creative Commons), permissions for further reuse of content should be sought from the publisher or author.

An Exploratory Study on the Northern Sea Route as an Alternative Shipping Passage

Helene Bareksten Solvang

Deloitte AS,
Dronning Eufemias gate 14,
0191, Oslo,
Norway
Tel: +47 482 79 755
Email: hsolvang@deloitte.no

Stavros Karamperidis^{*1}

Logistics Research Centre,
School of Social Sciences,
Heriot Watt University,
EH14 4AS, Edinburgh, UK
Tel: +44 (0)131 451 8432
Email: s.karamperidis@hw.ac.uk
ORCID ID: 0000-0003-0971-5187

Nikolaos Valantasis-Kanellos

National Institute for Transport and Logistics,
School of Transport Engineering, Environment and Planning,
Dublin Institute of Technology, Bolton Street,
D01 K822, Dublin,
Ireland
Tel: +353(0) 1 402 3898
Email: Nikolaos.valantasis@dit.ie
ORCID ID: 0000-0003-4871-9324

Dong-Wook Song

Shipping and Port Management
World Maritime University
P.O.Box 500
SE 201 24 Malmö
Sweden
Tel: +46 (0)40 356365
Email: ds@wmu.se
ORCID ID: 0000-0001-6435-1529

^{*} Corresponding author

¹ Department of International Shipping, Logistics and Operations, Plymouth Business School, University of Plymouth, 24 Sutton Road, PL4 0HJ, Plymouth, United Kingdom, Tel: +44 1752 585650, Email: stavros.karamperidis@plymouth.ac.uk

Abstract

This qualitative inductive research explores the potential benefits for the Scandinavian economy and ports through the implementation of the Northern Sea Route (NSR) as an alternative for container shipping to the established Southern route through the Suez Canal. To extract expert's opinions and address these objectives, we utilised in-depth face-to-face semi-structured interviews through purposive sampling in a single case study setting.

The analysis of the data demonstrates that the commercialisation of NSR can yield benefits for the Scandinavian economy (e.g. GDP increase, jobs creation) and reveals the benefits of Scandinavian ports (e.g. ECA's, flexibility, hinterland, etc.) compared to other ports in North West Europe, which potentially grasp the NSR as an opportunity. However, it is highlighted that this can only be achieved if Scandinavian countries are proactive and secure their involvement.

Key words

NSR, Scandinavian countries, Alternative Trade Route, Transshipment Hub, Containers.

1. INTRODUCTION

The current poor economic and trade environment caused by the financial crisis of 2008, and the oversupply of vessels creates mismatches in supply and demand in the shipping industry (UNCTAD 2016). Subsequently, to remain competitive and offer cost efficient shipping solutions, ship owners dropped freight rates considerably (Drewry 2016). The use of the Northern Sea Route (NSR) appears as an alternative to achieve further cost reductions due to shorter sailing distance compared to the southern route (Lasserre 2014). In particular, the use of NSR could benefit container transport due to reduced sailing distance and avoiding risks associated to southern route (Furuichi and Otsuka 2015). The utilisation of those benefits could lead to further reduction of transportation costs for container shipping which struggles to survive under the current tight operational environment, e.g. bankruptcy of Hanjin Shipping the former 7th largest container company in the world (Wright 2016). This paper aims to explore how Scandinavian economies and ports could flourish through the use of the NSR, as a viable alternative for container shipping.

The NSR, the passage along the Siberian coast, stretching from the Kola Peninsula in the West to the Bering Strait in the East, is part of the shortest connection between Northern Europe and Northeast Asia (i.e. Japan, South Korea, North-East China etc.) (Schøyen and Bråthen 2011). In these cases its navigational distance can be up to 40% shorter than the southern route via the Suez Canal (onwards stated as the Southern route, see Figure 1) (Liu and Kronbak 2010). The route was historically claimed and utilised by Russia as a national transport artery. However, in 1991, NSR opened to the international community, and currently recasts as an alternative trade route to the Southern route (Brubaker and Ragner 2010).

>>> Insert Figure 1 here <<<

According to NSIDC (2017), the annual average sea-ice extent of the Russian artic has been reduced on an accelerating rate over the past 40 years. Thus, it made NSR attractive to commercial shipping by being ice-free on an average of 6 months and not requiring escort of icebreakers for some days (McGrath 2017; Khon et al. 2017). That led to increased traffic, however, only destination traffic seems to be benefited while through-traffic has been reduced (Humpert 2017). In the period 2011-2016, a total of 217 vessels of multiple nationalities passed through NSR for commercial and scientific purposes (NSR Information Office 2017). Establishing NSR as an alternative transit trade route could provide more agile, adaptable and flexible supply chains, as further route choices can result in greater capacity, and may decrease the likelihood of congestion and disruption (Schøyen and Bråthen 2011).

The NSR is prolonged to comprise the entire Norwegian shoreline (See Figure 2), including innumerable Norwegian ports. However, limited research has been devoted to examine Norway's potential interest in the route and how that could affect the Scandinavian region. Gunnarsson (2014) calls for exploration of physical infrastructure in connection with a potential commercialisation of the NSR, including sufficient port facilities. Although Norway is small in comparison to Arctic "heavyweights" such as USA, Canada and Russia (Hastings 2014), its strategic geographical location for the European market has the potentials to make Norway an important player within the Scandinavian region.

The 10% annual growth in container shipping in 2014 in Norway (Haram 2015), was succeed by further increase in 2015 (Statistics Norway 2017). This implies that Norwegian container traffic currently experiences an increase, which may suggest that ports are already considering expansion opportunities to comply with this development. However, should the

NSR become commercialised there would be a distinct need for ports to engage in rapid development to secure Norway's, and as an extent Scandinavia's position as an Arctic actor. This opportunity further amplifies the need for exploratory research on the potential impact of NSR on Scandinavia's economy and ports.

>>> Insert Figure 2 here <<<

The remainder of this paper is divided as follows. Section 2 reviews the extant literature on the NSR, and highlights how Scandinavia could be benefited from NSR. Section 3 describes the methodological approach of the paper, and justifies the use of a case study. Thereafter, Section 4 presents the empirical findings of this research and critically compares them with the findings of the literature before presenting the conclusions in Section 5.

2. LITERATURE REVIEW

Maritime transportation forms the backbone of international trade (Talley and Ng 2013). In 2015, global seaborne container trade experienced an annual growth rate of 0.9% (down from 6.6% in 2014), reaching a total of 175 million TEUs (UNCTAD 2016, 2015). This marginal growth was the outcome of the sanctions imposed to Russia (Knowler 2016), weak Euro and inventories adjustments (UNCTAD, 2016). However, the Asia-Europe container volumes are estimated to grow by 40% from 2006 to 2030, and by 100% from 2006 to 2050, indicating that the positive trend will continue in the impending decades (DNV, 2010). This development is further reflected in the average ship size on this route, as it expanded from approximately 8,000 TEUs in 2009 to 10,300 in 2013 (Drewry 2015).

The continuous expansion of vessel sizes has also resulted in overcapacity; the cascading effect where ship capacity is moved from main trade routes to secondary routes or premature scrapping (e.g. seven-year old-Panamax container ship) (UNCTAD, 2016). The vessel type that suffers mostly is the old-Panamax, because ship owners attempt to reduce their operational cost by deploying larger vessels due to revoked restrictions of canals (e.g. the Panama Canal). However, by deploying old-Panamax² on the NSR (), ship owners would be able to compete the low operational costs achieved by larger container ships due to economies of scale (UNCTAD 2016) and avoid premature scrapping. Indubitably, as Merk (2016) argues, recently the economies of scale anticipated by the deployment of large container vessels, have been questioned due to vessels' low utilisation. Further, Merk (2016) asserts that ports and

² according to Meng et al. (2017) old-Panamax is mostly adopted from the literature due to draft restrictions.

terminals question the aforementioned benefits. Consequently, the deployment of fully utilised smaller vessels on shorter distances (e.g. NSR) could reduce the overall maritime transport operational costs. That shorter distance will be the case, as Asian mother ships are gradually abandoning Southeast Asia for Northern China (Verny and Grigentin, 2009).

Suez Canal is the predominant trade route between Asia and Europe, with particular benefits for container traffic (Verny and Grigentin 2009). Distinctively, 34% of the vessels navigating the canal in 2015 were container vessels (Suez Canal Traffic Statistics 2015). However, if the Suez Canal is to avoid congestion and disruption it must adapt to the continuous traffic growth (Drewry 2008). Therefore, the anticipated increase of container movements in combination with the finite capacity of the southern route creates an opportunity and motivation to explore other alternative trade routes.

2.1 A New Alternative Trade Route

The NSR lies in Arctic waters and within Russia's Exclusive Economic Zone (EEZ). Historically the route was governed by the Russian Administration of the NSR (ANSR) (Ragner 2000b). However, in March 2013 the NSR Administration (NSRA) replaced the old structure, thereby enabling a simpler administrative handling of vessels using the route (e.g. a four months' notice was replaced by an electronic 15-day minimum application notice system) (Moe 2014). Such administrative efficiencies improve the attractiveness and competitiveness of the NSR but still on a lagging level compared to the Suez Canal, which operates on a four days' notice basis (Suez Canal Authority 2015). Finally, the NSR fees became more transparent as the NSRA published tariffs for ships rendered by the ice-breaker FSUE "ATOMFLOT" (Novikov 2014).

2.2 Scandinavia in the Northern Sea Route

The Scandinavian country that has the largest exposure to the NSR is Norway, as Sweden and Finland are geographically isolated, and Denmark is far too close to the main European markets/ports. Thus, our focus is Norway, as its exposure to the NSR could positively affect the entire Scandinavian region. Historically, Norway has heavily utilised the natural resources of its surrounding oceans, which created a tradition of a world leading maritime nation (Brautaset and Tenold 2008). Norway's extensive coastlines, in combination with the country's substantial involvement in maritime activities (e.g. fisheries, oil and gas activities, etc. (Reve, 2012)), necessitated the development of numerous ports (See Figure 2). Although Norway is located on the same latitude as Northern Canada, Greenland and Northern Siberia, its climate is significantly warmer due to the North Atlantic Current (Amundsen and Lie 2011).

Consequently, Norwegian ports are ice-free all year around, thus ideal conditions for shipping activities are offered.

However, in past decades shipping has not been the driving force of the country's economy. The oil and gas sector constitutes 22% of the Norwegian GDP and 67% of the country's exports (European Commission 2015). Nevertheless, since early 2014 Norway has experienced an 'oil-crisis' provoked by the dwindling oil price, which resulted in significant jobs losses (Henley 2017). The above suggests that Norway needs new jobs opportunities related to the experience of the existing workforce. Shipping is a sector that can employ the redundant workforce, and generate opportunities to strengthen Norway's economy in the light of the declining of its main export. Through the use of North Norwegian ports, positive synergies could be created for both Sweden and Finland (thus Scandinavia as a whole). Such synergies could facilitate the transport of goods on Swedish and Finnish rail network, as there is not a good rail alternative from the North to the South within the Norwegian borders (Staalesen, 2017a). Through that rail network, also European products could be transferred (ibid). Finland have examined the opportunity of an "Arctic railway" to connect the North with markets in Central Europe. A Scandinavian collaboration could strengthen the possibility to make this happen as a shared effort between the Scandinavian countries (Staalesen, 2017b).

As the NSR embraces the entire Norwegian coast, that automatically provides Norway with a geographical advantage compared to other Arctic nations. The strategic position in combination with the country's arctic and maritime experience could potentially provide large opportunities for economy and ports.

Another factor suggesting the timeliness of Norway's appeal to the NSR is the establishment of Emission Control Areas (ECAs), with the purpose to regulate and minimise airborne emissions. According to IMO (2014), effective 2015, ships are required to use lower sulphur fuel within ECAs, as the maximum limit decreased from 1.00% to 0.10%. Consequently, sailing within ECAs increases operational costs (high low-sulphur fuels price), and operational complexities (procedure of switching fuels) (Hapag-Lloyd 2016). As the entire northern coast of Norway is positioned outside ECAs, Norwegian ports become attractive for the establishment of a transshipment hub, accommodating multimodal transport, along the route. Consequently, shipping lines could reduce operational costs on the Asia-Europe axis, through the use of cheaper sulphur fuels, and risks related to engine failure when vessels switch from normal to low-sulphur (Wain et al. 2005). Smaller feeder vessels, using low sulphur fuel, could then transport the cargo to neighbouring ports in Central Europe (Rotterdam, Hamburg, etc.)

inside the ECAs. That is a unique characteristic that Norway has in comparison with the other Scandinavian countries, as ECAs include only the Baltic and the North Sea (IMO, 2017). Thus, we focus on the Norwegian ports, as they are more attractive than the other Scandinavian ports for the NSR traffic.

2.3 Benefits from NSR on Container Shipping

Extant literature reports several costs and risks to consider when investigating the viability of the NSR as alternative route for container shipping. Firstly, ice-classed vessels are more expensive compared to ordinary vessels, with a capital cost premium of +20-40% (Lasserre 2014). Secondly, according to Sarrabezoles, Lasserre, and Hagouagn'rin (2016), the increased uncertainty and risk encountered, result in considerably higher insurance costs due to the limited international experience in underwriting insurance for ice-classed ships undertaking trans-Arctic voyages. Harsher navigational conditions suggest more damage to vessels, thus higher Repairs and Maintenance (R&M) costs (Schøyen and Bråthen 2011, Somanathan, Flynn, and Szymanski 2009). Further, the ice-breaking fee is one of the main voyage costs (Novikov 2014), in addition to fuel costs (Rahman, Saharuddin, and Rasdi 2014). Finally, liner companies have to account for the potential costs of delay due to uncertain ice-conditions (Verny and Grigentin 2009), and capacity utilisation costs, as the largest container ships cannot transit the NSR (Liu and Kronbak 2010). Notwithstanding, the NSR appears as more profitable than the Southern route, because the shorter sailing distance enables more rotations, thus transporting more TEUs (Lasserre 2014). Several studies indicate that sailing through NSR requires less fuel (Liu and Kronbak, 2010; Ragner, 2000 b; Wergeland, 2017), and is therefore more attractive should fuel prices rise as predicted by the International Energy Agency (Rapier 2016). Due to the novelty of the subject, we acknowledge that savings mentioned above are not conclusive (e.g. Lasserre et al., 2016; Pruyn, 2016; Meng et al., 2017).

Compared to the Southern route, container shipping on the NSR will generate new risks. Environmental aspects arise with increased maritime traffic shifted to a highly sensitive area, while Arctic operation imply increased risks as vessels face tougher navigational circumstances (Wergeland 1992). Thus, ships risk delays, which could lead to credibility damage and financial penalties (Lasserre 2014). Infrastructure on Russian territory appears underdeveloped and of poor standard (Xu et al. 2011, Lasserre 2014) – which in turn limits the ship service and repair possibilities (Ho 2010, Kitagawa 2008). Additionally, Ragner (2000a) argues that the network of ports fulfils only basic needs, with capacity and equipment deteriorating, which may delay stevedoring. Regardless, there could be opportunities for Norwegian ports to compete with, or replace the ports used by shipping lines along the route, as Norwegian ports are highly

developed and maintained due to oil and gas operations (Tormodsgard 2014). Ragner (2000a) further argues that safe navigation is dependent on ice-breakers, thus Russia actively builds new ice breakers with state-of-the-art features (Revesz 2017) resulting in a total of 40 ice-breakers with 11 on order (Osborn 2017). However, improved navigational circumstances along the NSR might make the use of these vessels unnecessary, as mentioned in section 1. Safety in terms of search and rescue is also an issue tackled by the recently issued Polar Code. However, Polar Code has been criticised both for narrow scope on safety and environmental aspects (Chircop 2016), thus does not burden the NSR users.

Finally, the Russian governance and policy to foreign vessel transits appear as decisive uncertainties, making shipping lines cautious towards investments in the region (Schøyen and Bråthen 2011). This risk could potentially be mitigated by establishing operations in Norway, which practices a more transparent regulatory framework³. According to the U.S. Department of State (2014, 1) Norway “welcomes foreign investments as a matter of policy and generally grants national treatment to foreign investors”. Consequently, establishing international transshipment operations in the country is easier. Compared to the Southern route, the Arctic is associated with greater risk levels (Appendix 1). However, shipping lines must consider these in relation to potential benefits, such as shorter sailing distance, reduced fuels costs, and increased productivity. DNV (2010) states that climate impacts from shipping is not restricted to the Arctic, and efforts to address global emissions will also benefit the Arctic. As air emissions from ships primarily correlate to travel distances, shorter shipping routes such as the NSR, may result in less environmental impact (Schøyen and Bråthen 2011). In addition, the use of NSR will reduce further the fuel consumption of containerships, which are the vessels with the worst CO₂ profile (only the 4,400 TEU category produces as CO₂ emissions as the entire crude oil tanker fleet) (Psaraftis and Kontovas, 2009). Thus, NSR will contribute to drastically reduce the CO₂ emissions of shipping. Considering the aforementioned aspects, the NSR appears as a viable option for container shipping compared to the Southern route thus Norwegian (and in extent Scandinavian) economy could grasp that benefit and succeed both in terms of increased GDP and reemploying the currently unutilized workforce laid off from the oil and gas sector.

³ Norway ranks 6/190 countries, while Russian Federation's rank 40th in the World Bank Doing Business Report (2017), and 6/176, in the Transparency International's Corruption Perceptions Index (2016) while Russian federation 131st.

3. RESEARCH METHODOLOGY

3.1 Case study

Barratt et al. (2011, 329) define a qualitative case study as ‘an empirical research that primarily uses contextually rich data from bounded real-world settings to investigate a focused phenomenon’. One of the strategy’s attributes is that it examines in depth at one, or a limited number of subjects; for example, one country, which is the perspective in this research. The case study strategy relies on several sources of evidence, which often include interviews, observation and documentary analysis converging in data triangulation (Yin 2009). Although multiple sources of data are one of the main strengths of the case study strategy, there are also several weaknesses.

There is restricted published literature examining the impact of NSR for Norway, and the Scandinavian region, indicating that a contribution from experts within Arctic development is necessary to collect reliable data. On this basis, 25 face-to-face interviews⁴ were conducted with highly ranked experts from ports, freight forwarders, shipping lines, government representatives as well as academics and consultants during the summer of 2015. The experts were all Norwegians, except one British arctic insurance expert, and one Danish academic in the field. The participants were considered appropriate because of their experience from current and past positions. Figure 3 presents the distribution of the participants based on their respective field of expertise. A common feature for container shipping research is the heavy presence of port- and shipping line participants, as they are the key actors in this sector (Slack 1985, Yap and Lam 2006).

>>> Insert Figure 3 here <<<

Ellram (1996) states that due to limited sample size, qualitative research findings cannot be generalised. However, Mitchell (1983) argues that the ability to generate theory from the research is more important than generalisability concerns.

Data collection ceases when saturation is achieved (Glaser and Strauss 1967); saturation is the point where no new insights are gained (Krueger and Casey 2014). On this basis, the researchers stopped collecting data after reaching 25 interviews.

⁴ Full version of questionnaires could be provided upon request.

3.2 Data Collection and Analysis

This paper utilises multiple techniques to gather qualitative data to achieve data triangulation and allow researchers to attain a fuller picture of the enquired phenomenon (Myers 2013). The literature review informed the interview questions, while a pilot interview, as suggested by Turner (2010), was conducted to determine potential weaknesses within the interview design.

For the collected data to be useful, it needs to be understood and analysed. Considering the relatively small sample size, and the inductive approach, a template analysis is conducted. Template analysis is a style of thematic analysis that balances the flexibility to adapt to the requirements of a specific study with a high degree of structure in the analysis (King 2012). A template is a list of “a-priori” and emergent codes, revised until all emergent threads of narrative are coded. The “a-priori codes” derive from the literature, whilst the emergent codes derive from the collected data (Cassell 2008).

4. FINDINGS AND DISCUSSION

4.1 Scandinavia’s Arctic Engagement

To set the context and elucidate Scandinavia’s Arctic engagement, interviewees were asked to comment on Scandinavia’s current position as an Arctic actor. In majority, they identified that Norway is a strong Arctic nation, with considerable experience in Arctic operations. Moreover, some experts highlighted that 80% of Arctic shipping takes place in Norwegian waters, thus describing Norway as a centre for Arctic economic activity. However, others believed Norway’s current position is unsatisfactory, especially regarding a potential commercialisation of the Arctic.

Eighty-eight percent of the interviewees emphasised Norway’s political involvement, describing it as a key element in the country’s Arctic engagement. Amongst them consensus that Norway has visible and active politics, with ambitions to be a leading nation in both utilising and preserving the Arctic was achieved, as illustrated below:

“Norway has promoted these areas as its main strategic priority, including a heavy commitment from the Norwegian authorities regarding awareness about the Arctic and the Northern areas, and the responsibility that is imposed” (Consultant 1).

Norway’s position in the Arctic Council was highlighted as highly influential, alongside the country’s efforts in Arctic preparedness and Search and Rescue (SAR) operations. Finally, Norway’s extensive relationship with Russia was of great importance, both politically and through cooperation.

Sixty-nine percent of interviewees responded that the NSR is of considerable importance for Norway, while the remaining 31% stated that the NSR is irrelevant. The divergent opinions are evident through the following statements:

“The NSR has a potential of becoming very important. One can compare it to what the Suez Canal has meant for Egypt” (Consultant 2) and “We have the Barents Sea and the fishing activities there, that is what is important for us today. In the future, it will be the oil and gas. We are not dependent on the NSR” (Consultant 3).

The empirical findings indicate that Norway, in comparison to other Scandinavian countries, has a relevant and solid position as an Arctic actor, both politically and through research related to maritime operations. This is further confirmed by the country’s position in the Arctic Council, where all the Arctic states have shown a dedicated interest in developing and implementing Arctic strategies (Norwegian Ministry of Foreign Affairs 2014). Thus, ensuring cooperation and dialogue across national borders. Furthermore, the geographical areas that Norway possess north of the Arctic Circle underpin the significance of Norway’s position – as illustrated in Figure 4.

>>> Insert Figure 4 here <<<

Nevertheless, 68% of the interviewees argued that the significance of the route lies in the long term. They also emphasised that should the route be commercialised; Norway would have to be proactive to secure its involvement, otherwise it would be a lost opportunity. Participation and investment by commercial stakeholders, as well as the Norwegian government, were further highlighted as important measures to secure the potential benefits.

While looking further into why NSR is important, several opportunities were mentioned, such as service, maintenance, supply and reloading. Furthermore, discussions regarding what Norway will do when the oil perishes were highlighted. The oil market in Scandinavia and specifically in Norway currently struggles, and thousands of jobs are lost (Business Insider Nordic 2016; News in English 2015). Consequently, some interviewees argued that the NSR could represent a great prospect for offshore companies to create new opportunities and solutions, thereby utilising the innovative business environment in the North. Although the majority considered NSR to be of importance, 32% of the interviewees underlined regional traffic in the North to be the most promising on a short-term basis.

Scandinavian Economy and NSR

For Scandinavia to engage in a potential commercialisation of NSR, it is essential to understand why the NSR could be important. Increased traffic on the NSR implies increased activity along the Norwegian coastline, thus creating substantial business opportunities, particularly for ports.

In correspondence with the consensus concerning Norway's arctic engagement, interviewees consent on the potential economic benefits of NSR for the Norwegian economy and the overall Scandinavian economy, if several conditions are met. Figure 5 summarises the relevant responses.

>>> Insert Figure 5 here <<<

Nevertheless, some interviewees stated the opinion that these benefits are relative to the development costs, as the macroeconomic equation might show that Norway is left with less surplus than initially expected. However, others assert that the marginal cost of developing suitable container terminals in the North would be limited to building the terminals. That is because Norway has large part of its population living north of the Arctic Circle, with a considerably more modern economy and settlements than other Scandinavian countries. Thus, infrastructure (e.g. power plants, hospitals, airports and diversified business clusters) to support such a venture already exists.

However, as the findings specified, Norway must be prepared and equipped for such an increase to secure its involvement. This will require private and public sector investments. However, the unspecified scale of these investments could delay Norway's deployment in NSR. The implications of such delay is that ships will not have any incentive to call Norwegian ports. As such, Norway might lose the competitive advantage provided by its strategic geographical location. Both empirical and literature review findings support that, Norway is not reliant on the NSR due to already established and profitable industries (e.g. fishing, oil and gas sector). Thus, governmental and private actors may hesitate to invest in new and uncertain business areas, such as the NSR.

Employment

The economic importance of NSR for Norway was further highlighted by the comments of interviewees about the positive relationship between the commercialisation of NSR and the potentials for more jobs, and thereby more wealth in the Norwegian society, as stated below:

“There is a potential in the NSR, and Norway will benefit from a commercialisation of the route. It will increase the activity in the ports, which will also increase the number of jobs. This is absolutely impossible to quantify, but there is a positive relationship which we can be quite confident about” (Academic in the field, Denmark).

Conversely, others argued that the opportunities the NSR may provide in terms of service, maintenance and supply are too large to ignore. Despite Norway’s modest population of five million, the country possess the world’s 4th largest fleet (European Commission 2017). This further underpins the country’s involvement in maritime operations, including an environment that is ready to exploit the benefits of increased activity. Furthermore, the country is currently undergoing an ‘oil-crisis’ where more than 30,000 jobs are already lost (Business Insider Nordic 2016; News in English 2015).

To further understand the importance of NSR, we inquired the potential economic and job generating implications of the route. Although there was no consensus regarding whether the NSR is of importance, a clear majority of interviewees (88%) responded that they believe the route, if commercialised, would benefit the economy and create more jobs if utilised correctly. Norway has 10% of its population living North of the Arctic Circle – more than any other country in the world (Norwegian Ministry of Foreign Affairs 2014). Thus, the potential implications of increased traffic along the Norwegian coastline could contribute to generating a higher economic activity in these areas. This is confirmed by Næs (2015) stating that the NSR has the potential of creating thousands of new jobs in Northern Norway.

4.2 Norwegian Ports in Relation to the NSR

Increased Vessel Size

The general perception of the interviewees was that container vessels are continuously enlarged, mainly due to competition between shipping lines. Some interviewees argued that the increase is necessary to reduce shipping costs, notwithstanding others emphasised on the infrastructural and operational challenges the increasing vessel size imposes to ports. However, as the largest vessels currently trade between Asia and Europe, Norwegian ports are exposed to feeder vessels, which according to a shipping line representative are also enlarged, from an average of 400-450 TEUs in 1996 to 1,000-1,100 TEUs in 2015. However, 60% of the interviewees argued that the general increase would not have a major impact on Norwegian ports, as the NSR cannot accommodate ships larger than 4,000 TEUs because of natural depth restrictions.

ECAs

The interviewees were further asked to comment on the effect of ECAs to the routing and port selection of shipping lines. Eighty percent of the participants asserted that ECAs will have an impact, but a smaller percentage elaborated that this might only be a ‘temporary problem’ as eventually shipping lines would have to adapt. Others argued that this could be critical for some shipping companies, especially those engaged in short-sea shipping where it is easier to shift the goods to onshore alternatives. Nevertheless, the remaining four responded that ECAs do not have any implications for container shipping, as they are heavily dependent on several of the major ports inside the area, such as Rotterdam. This might be due to fuel costs at present being very low, and could change if the costs rise.

Flexibility

In majority, Norwegian ports were perceived as flexible and able to provide satisfactory service level. The size of the ports was highlighted, as smaller ports can easily adjust to shipping lines requirements. A shipping line representative stated that several of the major ports in Europe have difficulties in adapting to specific needs. Since these are established ports in areas with intense competition, they might benefit more from minimising their costs. Thus, creating a conflict between total flexibility and cost minimisation. However, the remaining interviewees (12%) argued that Norwegian ports suffer from a rigid system imposed by public or semi-public governance. Thus, some ports struggle to keep up with the needs of the industry and the commercial activity. For example, Consultant 1 stated that if a community has a profit generating port, then it is tempting to invest the surplus in nursing homes rather than new port infrastructure.

Environmental Aspects

To elucidate the environmental aspects of Norwegian ports, port representatives were asked if they have environmental policies. The concurring points are illustrated in Table 1.

>>> Insert Table 1 here <<<

The interviewees were asked to comment on the potential of the above mentioned aspects to attract more customers to the ports. Some responded that this is very difficult to measure, but emphasised that a strong environmental focus is advantageous. Others argued that shipping lines are more concerned with costs rather than environmental aspects referring to examples where shipping lines chose cost efficient ports over environmental friendly ports.

Hinterland

Norway at present is not able to facilitate trade generated by NSR, if the goods are to be distributed through the country. That is because of the lack of appropriate rail and road infrastructure networks. However, a majority further highlighted the opportunity of establishing a transshipment hub, which eliminates the need of a strong and wide-ranging hinterland. This requires the construction of special terminals in the North, currently non-existent because:

“There has not been a need. First, you need a market to build the infrastructure, and there is no infrastructure without a market, so somebody must start. However, there are quite definite plans to develop the ports up there, but there have been no decisions yet”

(Consultant 1).

Connection to other European Ports

Sixty percent responded that they perceive Norwegian ports to have good connections to other European ports in terms of both frequency and tonnage. The remaining 40% highlighted that Norway lies outside the central distribution network for international container transportation, and that Norwegian ports, both together and separately, represent a relatively small percentage of the European freight volume. However, it was noted that if Norway established a transshipment hub, they would automatically gain a good connection to other European ports.

Benefits Compared to other European Ports

Thirty-six percent responded that there are no benefits as of today, while the remaining 64% argued that there are several benefits. The main points of concurrence are gathered in Table 2, while Figure 6 presents the recurrence of those points.

>>> Insert Table 2 here <<<

>>> Insert Figure 6 here <<<

The main emphasis was on the opportunity of establishing a transshipment hub, while the other benefits were evenly distributed. Although the focus was to explore the potential benefits compared to other established hubs in Europe, 56% of the interviewees argued that it is more a question of competing with Russian ports, as stated below:

“Norway is probably better equipped to make it in the North; we have the container port in Kirkenes, with the same ambitions in Tromsø. There is no doubt that with relatively

simple measures Norwegian ports could offer a better international shipping service than the Russian ports” (Consultant 1).

Norwegian ports could provide a stable political environment high level of technology, an unmistakably better infrastructure, good communication systems, and SAR operations compared to Russian ports. It was highlighted that Norway has an open society with a regulatory framework, which in comparison to many other nations is very predictable and reliable. Consequently, shipping lines can expect fixed prices and no bribing. Finally, ice-free ports throughout the year and Norway’s experience in Arctic operation further suggest good conditions for container shipping.

There was a consensus amongst the interviewees that Norwegian ports can satisfy the customised needs of shipping lines. The ports were considered as more agile than other European ports, where cost minimisation was described to be of greater concern. However, a problem that surfaced was the public ownership of the ports. If Norwegian ports should be able to provide benefits compared to other European ports, as well as establishing the needed infrastructure to serve the NSR, this might require government involvement. As indicated by Brooks and Cullinane (2006) port improvement and restructuring activities initiated by governments on the part of taxpayers and citizens can cause noteworthy unhappiness, although evidence suggests that such port networks prove more efficient and commercially reactive. Based on the findings, Norwegian ports were described to have a strong environmental focus. Whether this would contribute to providing a competitive advantage was difficult to verify, especially since shipping lines appear to be more concerned with costs rather than environmental engagements.

Considering the hinterland off Norwegian ports, the most promising opportunity is the establishment of a transshipment hub, since this can be done regardless of the identified weaknesses within the hinterland. However, this requires construction of specially designed terminals, which would require public and private investments, as well as a clear understanding of the benefits Norway could reap by exploiting the first-mover advantage.

A final point of discussion was whether Norwegian ports could offer benefits compared to other European ports, where the most frequently mentioned benefit was the possibility of transshipment as the NSR is lacking suitable ports along the route. A transshipment hub on both sides of the NSR, for example Norway and Alaska, could make vessels independent of the poor infrastructure along the Russian coast. Furthermore, it could limit the use of ice-classed vessels to the required areas. The findings indicated that a transshipment hub on the Norwegian side,

rather than the Russian, could yield several benefits to shipping lines. The benefits are amongst others; stable regulatory framework, transparent overview of charges and fees, less risk of corruption, ice-free harbours and modern port facilities. The container port in Kirkenes represents the closest point to where an expensive ice-classed vessel is no longer needed and according to the interviewees is highlighted as the most suitable point to establish a transshipment hub. Although the NSR is currently only open six months a year (Khon et al., 2017; Meng et al., 2017), Figure 7 illustrates the additional trade volumes that could generate activity for the port. Hence, creating a year-round operation and further justifying its position. However, the required port infrastructure is not yet in place – but can be developed fast. Cases of other countries establishing transshipment hubs exist. For example, Dubai managed to take full advantage of its strategic location concerning the growing container traffic between east and west, by constructing one of the most modern port facilities in the region (Jacobs and Hall 2007). Such an establishment could also be initiated in Norway to exploit the potentially growing container volumes on the NSR, given that the Norwegian government, Scandinavian region and private businesses commit to the development.

>>>>Insert Figure 7 here<<<<

5. CONCLUSIONS

The overall aim of this paper was to explore whether NSR's commercialisation could yield benefits for the Scandinavian economy and ports. Various costs and risks were identified as distinctive for Arctic shipping. However, this must be seen in relation to the benefits that the NSR may offer, such as shorter distance, substantially reduced fuel costs and increased productivity. For this reason, we conclude that the NSR can be a viable alternative to the Southern route.

By discussing the findings from the case study, the researchers found that the commercialisation of NSR could create many opportunities for Scandinavia through Norway, thus the route can be considered of high importance for Scandinavia. The potential implications to the Scandinavian economies further underpin the importance of the route, as this could provide positive synergies for businesses and create more jobs if utilised the right way. To investigate that, future research is needed in order to identify the type of strategy (or strategies) the Norwegian ports need to implement. Under those strategies, the environmental impact for using the NSR should also be examined.

We argue that there are several benefits for calling Norwegian ports against Northwest European ports because of their strategic location, free capacity and large areas for future expansion. However, there are also limitations in the current port network such as unsatisfactory infrastructure and restricted hinterland. Nevertheless, we conclude that the principal reason for shipping lines operating the NSR to call Norwegian ports is the benefits a transshipment hub in Northern Norway can offer e.g. transparent regulatory framework, decreased need for ice-classed vessels and independence of the inadequate ports along the route.

This paper focussed exclusively on container shipping on the NSR, and therefore disregarded other cargo types. Considering that destination traffic is strong in NSR, particularly for oil and gas, future research could examine the opportunities of Scandinavian countries and specifically Norway in these markets. Additionally, it could be of interest to explore commodities that are valuable but not time restricted such as cars. Thus, investigating car carriers, which face smaller penalties for being late, could potentially improve the attractiveness of NSR for through-traffic too. Norway has one of the world's largest car carrier fleets, comprising shipping companies such as Norwegian Car Carriers (NOCC) and Høeg Autoliners which own some of the largest vessels (8,500 car equivalent units) (Høeg Autoliners 2017, NOCC 2017). Investigating the NSR with a focus on car carriers could assist Norwegian ship owners in operating the route, as they will primarily support their own country. Additionally, a comparison of containerised and not containerised transportation on the NSR could reveal unexpected differences in terms of costs, risks and therefore the viability of the route. Finally, the possible opening of a rail alternative from Northern Europe to Asia received little attention in this study. Such an establishment could be a competitor to the NSR, and thereby undermine its potentials. Furthermore, Norway is not the only nation to be benefited by the commercialisation of the NSR but the whole Scandinavia, as rail and road infrastructure would be utilised. Therefore, it is of vital significance that Norway is proactive and exploits the first-mover advantage to secure its involvement and future profit.

Limitation of this paper is that the lack of appropriate research on Scandinavia, in relation to the NSR, may have caused the researchers to put too much emphasis on subjective opinions. Thus, its outcomes cannot be generalizable, as it is mainly focused on the Scandinavian economy and ports. Additionally, the paper lacks to identify managerial implications especially concerning the strategy or the strategies to be set up by the Scandinavian government and port authorities (medium-long run) to position the countries (specifically Norway) as a hub for Arctic shipping in the container sectors and others. It would be interesting for future research to

identify the role of the Norwegian maritime cluster in this strategy. Finally, future research could try to identify Scandinavia's existing repair-maintenance and SAR infrastructure, which could be important for the developed traffic.

References

- Amundsen, B., and E. Lie. 2011. "The chaotic current that warms Norway." *The Research Council of Norway*, December 02. http://www.forskningsradet.no/prognett-norklima/Nyheter/The_chaotic_current_that_warms_Norway/1253970052900?lang=en.
- Arctic Council. 2009. "Arctic Marine Shipping Assessment 2009 Report." *Arctic Council*, April, https://www.pmel.noaa.gov/arctic-zone/detect/documents/AMSA_2009_Report_2nd_print.pdf
- Barratt, M., T.Y. Choi., and L. Mei. 2011. "Qualitative case studies in operations management: Trends, research outcomes, and future research implications." *Journal of Operations Management* 29 (4): 329-342. doi:10.1016/j.jom.2010.06.002.
- Brautaset, C., and S. Tenold. 2008. "Globalisation and Norwegian shipping policy, 1850-2000." *Business History* 50 (5): 565-582. doi:10.1080/00076790802245949.
- Brooks, M.R., and K. Cullinane. 2006. *Devolution, port governance and port performance*. Vol. 17 of *Research in Transportation Economics*. London: Elsevier.
- Brubaker, R. D., and C. L. Ragner. 2010. "A review of the International Northern Sea Route Program (INSROP) - 10 years on." *Polar Geography* 33 (1-2): 15-38. doi:10.1080/1088937X.2010.493308.
- Business Insider Nordic. 2016. "40,000 oil jobs in Norway have been shed in a short time." *Business Insider Nordic*, November 1. <http://nordic.businessinsider.com/40-000-oil-jobs-in-norway-have-been-shedded-2016-11>
- Cassell, C. 2008. "Template Analysis." In *The SAGE dictionary of qualitative management research*, edited by Thorpe R., and R. Holt, 220-222. London: Sage
- Chircop, A. 2016. "Sustainable Arctic Shipping: Are Current International Rules for Polar Shipping Sufficient?" *The Journal of Ocean Technology* 11 (3): 39-51. <https://ssrn.com/abstract=2847027>
- Dalsoren, S. B., O. Endresen, I.S.A. Isaksen, G. Gravir, and E. Sorgard. 2007. "Environmental impacts of the expected increase in sea transportation, with a particular focus on oil and gas scenarios for Norway and northwest Russia", *Journal of Geophysical Research-atmospheres*, 112 (D2): 1-30. doi: 10.1029/2005JD006927
- DNV. 2010. "Shipping across the Arctic Ocean: A feasible option in 2030-2050 as a result of global warming?" *Research and Innovation, Position Paper 4*. http://www.lappi.fi/c/document_library/get_file?folderId=1190621&name=DLFE-19482.pdf.
- Drewry. 2008. *Container Forecast*. London: Drewry.
- Drewry. 2009. *Risk Management in International Transport and Logistics*. London: Drewry Shipping Consultants Ltd
- Drewry. 2015. "Fuel savings not enough." *Drewry*, June 05. <http://ciw.drewry.co.uk/release-week/2015-34/>.
- Drewry. 2016. "Market conditions force down ship operating costs." *Drewry*, December 05. <https://www.drewry.co.uk/news/market-conditions-force-down-ship-operating-costs>.
- Ellram, L. M. 1996. "The Use of the Case Study Method in Logistics Research." *Journal of Business Logistics* 17 (2): 93-138.

- European Commission. 2017. "Countries and Regions: Norway." *European Commission*, October 20. accessed 22.02.2018. <http://ec.europa.eu/trade/policy/countries-and-regions/countries/norway/>.
- Eyring, V., I.S.A. Isaksen, T. Berntsen, W.J. Collins, J.J. Corbett, O. Endresen, R.G. Grainger, et al. (2010) "Transport impacts on atmosphere and climate: Shipping." *Atmospheric Environment*, 44, pp. 4735-4771. doi: 10.1016/j.atmosenv.2009.04.059
- Falck, H. 2012. "Shipping in Arctic Waters: The Northern Sea Route", presented in Marine Insurance Seminar 2012, Mariehamn, April 26.
- Fu, X., A. K. Y. Ng, and Y. Y. Lau. 2010. "The impacts of maritime piracy on global economic development: The case of Somalia." *Maritime Policy and Management* 37 (7): 677-697. doi: 10.1080/03088839.2010.524736.
- Furuichi, M., and N. Otsuka. 2015. "Proposing a common platform of shipping cost analysis of the Northern Sea Route and the Suez Canal Route." *Maritime Economics & Logistics* 17 (1): 9–31. doi: 10.1057/mel.2014.29
- Glaser, B., and A. Strauss. 1967. *The Discovery of Grounded Theory*. Chicago, IL: Aldine.
- Gunnarsson, B. 2014. "The Future of Arctic Marine Operations." In *The Arctic in World Affairs: A North Pacific Dialogue on the Future of the Arctic*, edited by Oran R. Young, O.R., J.D. Kim, and Y.H. Kim., 37-61. Seoul: Korea Maritime Institute; Honolulu: East-West Center.
- Hapag-Lloyd. 2016. "Industry Insight: Hapag-Lloyd Explains How a Vessel Switches to Low Sulfur Fuel When Entering an ECA." *Ship & Bunker*, January 11. <http://shipandbunker.com/news/features/industry-insight/627652-industry-insight-hapag-lloyd-explains-how-a-vessel-switches-to-low-sulfur-fuel-when-entering-an-eca>.
- Haram, H.K. 2015. "Record growth for containers in 2014." *Shortsea Shipping*, April 29. <http://www.shortseashipping.no/News/3004/Rekordvekst-for-container-i-2014>.
- Hastings, J. G. 2014. "The rise of Asia in a changing Arctic: a view from Iceland." *Polar Geography* 37 (3): 215-233 doi:10.1080/1088937X.2014.934315.
- Henley, J. 2017. "Norway goes to the polls with the future of its oil and gas industry in play." *The Guardian*, September 10. <https://www.theguardian.com/world/2017/sep/10/norway-goes-polls-future-oil-gas-industry-green-party-kingmaker>
- Ho, J. 2010. "The implications of Arctic sea ice decline on shipping." *Marine Policy* 34 (3): 713-715. doi:10.1016/j.marpol.2009.10.009.
- Husdal, J., and S. Bråthen. "Bad locations, bad logistics? How Norwegian freight carriers handle transportation disruptions." Paper presented at the World Conference for Transportation Research 2010, Lisbon, July 11-15.
- Humpert, A. M. 2017. "Shipping Traffic on Northern Sea Route Grows by 30 Percent." *High North News*, January 23. <http://www.highnorthnews.com/shipping-traffic-on-northern-sea-route-grows-by-30-percent/>.
- IMO. 2014. "Ships face lower sulphur fuel requirements in emission control areas from 1 January 2015." *IMO*, December 23. <http://www.imo.org/en/MediaCentre/PressBriefings/Pages/44-ECA-sulphur.aspx#.Wo7ClujFK70>.
- IMO. 2017. "Sulphur oxides (SOx) – Regulation 14." IMO. Accessed September 22 2017. [http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-\(SOx\)-%E2%80%93Regulation-14.aspx](http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-(SOx)-%E2%80%93Regulation-14.aspx).
- Jacobs, W., and P.V. Hall. 2007. "What conditions supply chain strategies of ports? The case of Dubai." *GeoJournal* 68 (4):327-342. doi: 10.1007/s10708-007-9092-x
- Khon, V.C., I.I. Mokhov, and V.A. Semenov. 2017. "Transit navigation through Northern Sea Route from satellite data and CMIP5 simulations." *Environmental Research Letters* 12 (2): 1-7. doi:10.1088/1748-9326/aa5841

- King, N. 2012. "Doing template analysis." In *The Practice of Qualitative Organizational Research: Core Methods and Current Challenges*, edited by Symon G. and K. Cassell, 426-450. London: Sage.
- Kitagawa, H. 2008. "Arctic routing: Challenges and opportunities." *WMU Journal of Maritime Affairs* 7 (2): 485-503. doi:10.1007/BF03195147.
- Knowler, G. 2016. "Negative growth in Asia-Europe trade spills into 2016." *JOC.com*, March 8. http://www.joc.com/maritime-news/trade-lanes/asia-europe/negative-growth-asia-europe-trade-spills-2016_20160308.html.
- Krueger, R., and M. A. Casey. 2014. *Focus Groups: A Practical Guide for Applied Research*. 5th ed. London: SAGE Publications.
- Kum, S., and B. Sahin. 2015. "A root cause analysis for Arctic Marine accidents from 1993 to 2011." *Safety Science* 74 (4): 206-220. doi:10.1016/j.ssci.2014.12.010.
- Lasserre, F. 2014. "Case studies of shipping along Arctic routes. Analysis and profitability perspectives for the container sector." *Transportation Research Part A: Policy and Practice* 66 (1): 144-161. doi:10.1016/j.tra.2014.05.005.
- Lasserre, F., L. Beveridge, M. Fournier, P.L. Têtu, and L. Huang. (2016) "Polar seaways? Maritime transport in the Arctic: An analysis of shipowners' intentions II", *Journal of Transport Geography* 57 (12): 105-114. doi:10.1016/j.jtrangeo.2016.10.004
- Lasserre, F., and S. Pelletier. 2011. "Polar super seaways? Maritime transport in the Arctic: an analysis of shipowners' intentions." *Journal of Transport Geography* 19 (6):1465-1473. doi: 10.1016/j.jtrangeo.2011.08.006.
- Liu, M., and J. Kronbak. 2010. "The potential economic viability of using the Northern Sea Route (NSR) as an alternative route between Asia and Europe." *Journal of Transport Geography* 18 (3): 434-444. doi:10.1016/j.jtrangeo.2009.08.004.
- Merk, O. 2016. "Economies of scale; a defunct shipping model?". Shipping Today, accessed 13.02.2017. <http://shippingtoday.eu/economies-of-scale-shipping-model/>.
- Meng, Q., Y. Zhang, and M. Xu. 2017. "Viability of transarctic shipping routes: a literature review from the navigational and commercial perspectives." *Maritime Policy & Management* 44 (1): 16-41. doi:10.1080/03088839.2016.1231428
- Mitchell, J. C. 1983. "Case and situation analysis." *The Sociological Review* 31 (2): 187-211. doi: 10.1111/j.1467-954X.1983.tb00387.x.
- Moe, A. 2014. "The Northern Sea Route: Smooth Sailing Ahead?" *Strategic Analysis* 38 (6): 784-802. doi:10.1080/09700161.2014.952940
- Mostafa, M.M. 2004. "Forecasting the Suez Canal traffic: a neural network analysis." *Maritime Policy & Management* 31 (2):139-156. doi:10.1080/0308883032000174463
- Myers, M. D. 2013. *Qualitative Research in Business and Management*. 2nd ed. London: Sage.
- Næs, T. 2015. "Care for Arctic people trumping Northern Silk Road vision." *GB Times*, June 28. <http://gbtimes.com/world/care-arctic-people-trumping-northern-silk-road-vision>.
- News in English. 2015. "Job uncertainty grips Norwegians." *News in English*, August 21. <http://www.newsinenglish.no/2015/08/21/job-uncertainty-grips-norwegians/>
- Norwegian Ministry of Foreign Affairs. 2014. *Norway's Arctic Policy*. https://www.regjeringen.no/globalassets/departementene/ud/vedlegg/nord/nordkloden_en.pdf.
- Notteboom, T. 2006. "The time factor in liner shipping services." *Maritime Economics & Logistics* 8 (1): 19-39. doi:10.1057/palgrave.mel.9100148
- Notteboom, T. 2012. "Towards a new intermediate hub region in container shipping? Relay and interlining via the Cape route vs. the Suez route." *Journal of Transport Geography* 22 (5):164-178. doi: 10.1016/j.jtrangeo.2012.01.003.

- Novikov, S. 2014. "Tariffs for the icebreaker escorting of ships rendered by FSUE "ATOMFLOT" in the water area of the Northern Sea Route." Northern Sea Route Administration, March 31.
http://www.nsra.ru/en/ofitsialnaya_informatsiya/tariffs_for_icebreaker_escort_atomflot/f79.html
- NSIDC. 2017. "Arctic sea ice at minimum extent." *NSIDC*, September 10.
<https://nsidc.org/news/newsroom/arctic-sea-ice-minimum-extent>.
- NSR Information Office. 2017. "Transit Statistics." *Centre for High North Logistics*. Accessed 11.02.2017. http://www.arctic-lia.com/nsr_transits.
- Osborn, A. 2017. "Putin's Russia in biggest Arctic military push since Soviet fall." *Reuters*, January 30. <https://www.reuters.com/article/us-russia-arctic-insight/putins-russia-in-biggest-arctic-military-push-since-soviet-fall-idUSKBN15E0W0>
- Pruyn, J.F.J. 2016. "Will the Northern Sea Route ever be a viable alternative?" *Maritime Policy & Management*, 43 (6): 661-675. doi:10.1080/03088839.2015.1131864
- Psaraftis, H.N. and C.A. Kontovas. 2009. "CO₂ emission statistics for the world commercial fleet." *WMU Journal of Maritime Affairs* 8 (1): 1-25. doi:10.1007/BF03195150
- Qi, X., and D.P. Song. 2012. "Minimizing fuel emissions by optimizing vessel schedules in liner shipping with uncertain port times." *Transportation Research Part E* 48 (4):863-880. doi: 10.1016/j.tre.2012.02.001.
- Talley, W. K. and Ng, M. (2013) 'Maritime transport chain choice by carriers, ports and shippers', *International Journal of Production Economics*, 142, pp. 311-316.
- Ragner, C. L. 2000a. *Northern Sea Route Cargo Flows and Infrastructure - Present State and Future Potential*. Lysaker: The Fridtjof Nansen Institute (FNI)
<https://www.fni.no/getfile.php/132017/Filer/Publikasjoner/FNI-R1300.pdf>
- Ragner, C. L., ed. 2000b. *The 21st Century—Turning Point for the Northern Sea Route?* Dordrecht: Springer Netherlands. doi: 10.1007/978-94-017-3228-4
- Rahman, NSF Abdul, A. H. Saharuddin, and R. Rasdi. 2014. "Effect of the Northern sea route opening to the shipping activities at Malacca straits." *International Journal of e-Navigation and Maritime Economy* 1: 85-98. doi:10.1016/j.enavi.2014.12.008
- Rapier, R. 2016. "IEA Projects a 75% Increase In Oil Prices By 2020." *Forbes*, November 30.
<http://www.forbes.com/sites/rrapier/2016/11/30/iea-projects-a-75-increase-in-oil-prices-by-2020/#7cb547b7778e>.
- Reve, T. 2012. "The Transformation of the Norwegian Maritime Industry to a Global Maritime Knowledge Hub." *OECD*, November 29. Accessed: 01 September 2017.
<https://www.oecd.org/sti/ind/9%20Reve%20-%20BI%20-%2029Nov2012.pdf>
- Revesz, R. 2017 "Russia launches 'world's biggest and most powerful' nuclear icebreaker ship." *Independent*, September 25.
<http://www.independent.co.uk/news/world/europe/russia-nuclear-icebreaker-ship-sibir-world-biggest-most-powerful-northern-sea-route-baltic-shipyard-a7965596.html>.
- Sarrabezoles, A., F. Lasserre, and Z. Hagouagn'rin. 2016. "Arctic shipping insurance: Towards a harmonisation of practices and costs?" *The Polar Record* 52 (4): 393-398. doi:10.1017/S0032247414000552
- Schøyen, H., and S. Bråthen. 2011. "The Northern Sea Route versus the Suez Canal: cases from bulk shipping." *Journal of Transport Geography* 19 (4): 977-983. doi:10.1016/j.jtrangeo.2011.03.003.
- Slack, B. 1985. "Containerisation, inter-port competition and port selection." *Maritime Policy & Management* 12(4): 293-303. doi:10.1080/03088838500000043
- Somanathan, S., P. Flynn, and J. Szymanski. 2009. "The Northwest Passage: A simulation." *Transportation Research Part A* 43 (2): 127-135. doi:10.1016/j.tra.2008.08.001.

- Staalesen, A. 2017a. "Norway Positive To Finland's Arctic Railway Plan." *The Barents Observer*, April 12. <https://thebarentsobserver.com/en/arctic/2017/04/norway-positive-finlands-arctic-railway-plan>.
- Staalesen, A. 2017b. "EU Opens Up For New Arctic Infrastructure." *The Barents Observer*, April 29. <https://thebarentsobserver.com/en/2016/04/eu-opens-new-arctic-infrastructure>
- Statistics Norway. 2017. "Maritime Transport, 3rd quarter of 2017." *Statistics Norway*, December 13. accessed 22.02.2018. <https://www.ssb.no/en/transport-og-reiseliv/statistikker/havn>.
- Talley, W.K., and M. Ng. 2013. "Maritime transport chain choice by carriers, ports and shippers." *International Journal of Production Economics* 142 (2): 311-316. doi:10.1016/j.ijpe.2012.11.013.
- The World Bank. 2017. "Doing Business Report: Ease of Doing Buisness in Norway." The World Bank. Accessed 19.03.2017. <http://www.doingbusiness.org/data/exploreeconomies/norway>.
- Tormodsgard, Y. 2014. *FACTS 2014 - The Norwegian Petroleum Sector*. Ministry of Petroleum and Energy. http://www.npd.no/Global/Engelsk/3-Publications/Facts/Facts2014/Facts_2014_netto.pdf
- Transparency International. 2016. "Corruption perceptions Index 2016." *Transparency International*, January 25. http://www.transparency.org/news/feature/corruption_perceptions_index_2016.
- Tummala, R., and T. Schoenherr. 2011. "Assessing and managing risks using the Supply Chain Risk Management Process (SCRMP)." *Supply Chain Management - An International Journal* 16 (6): 474-483. doi:10.1108/13598541111171165
- Turner, D.W. 2010. "Qualitative interview design: a practical guide for novice investigators." *The Qualitative Report* 15 (3): 754-760. <http://nsuworks.nova.edu/tqr/vol15/iss3/19>
- U.S. Department of State. 2014. *2014 Investment Climate Statement (Norway)*. <https://www.state.gov/documents/organization/228196.pdf>.
- UNCTAD. 2015. *Review of Maritime Transport 2015*. UNCTAD/RMT/2015. Geneva: United Nations Conference on Trade and Development.
- UNCTAD. 2016. *Review of Maritime Transport 2016*. UNCTAD/RMT/2016. Geneva: United Nations Conference on Trade and Development.
- Verny, J., and C. Grigentin. 2009. "Container shipping on the Northern Sea Route." *International Journal of Production Economics* 122 (1): 107-117. doi:10.1016/j.ijpe.2009.03.018.
- Vidal, J. 2013. "Rapid Arctic thawing could be economic timebomb, scientists say." *The Guardian*, July 25. <http://www.theguardian.com/environment/2013/jul/24/arctic-thawing-permafrost-climate-change>.
- Wain, K.S., J.M. Perez, E. Chapman, and A.L. Boehman. 2005. "Alternative and low sulfur fuel options: boundary lubrication performance and potential problems." *Tribology International* 38 (3): 313-319. doi:10.1016/j.triboint.2004.08.014.
- Wergeland, T. 1992. *Commercial Requirements for a Viable Shipping Operation along the NSR*. Norway: INSROP Work Paper.
- Wergeland, T. 2017. "Arctic Shipping Routes - Cost Comparisons with Suez." ARCTIS Knowledge Hub. Accessed: August 31 2017. <http://www.arctis-search.com/Arctic+Shipping+Routes+-+Cost+Comparisons+with+Suez>
- Wright, R. 2016. "Hanjin bankruptcy brings chaos but no capacity cut." *Financial Times*. September 1. <https://www.ft.com/content/205af87a-6fba-11e6-a0c9-1365ce54b926>.
- Xu, H., D. Jia, Z. Yin, F. Jin, and H. Ouyang. 2011. "The potential seasonal alternative of Asia-Europe container service via Northern sea route under the Arctic sea ice retreat." *Maritime Policy & Management* 38 (5): 541-560. doi:10.1080/03088839.2011.597449.

- Yap, W.Y., and J.SL. Lam. 2006. "Competition dynamics between container ports in East Asia." *Transportation Research Part A* 40 (1): 35-51. doi:10.1016/j.tra.2005.03.001.
- Yin, R. K. 2009. *Case Study Research: Design and Methods*. 4th ed. Thousand Oaks, CA: Sage.

Appendix 1: Identified Risks of Container Shipping on the NSR and Suez Canal Route

>>> Insert Table 3 here <<<